

What Do Engineers and Computer Scientists Need to Know Beyond their Technical Courses?

There is a lot more to an engineering or computer science education than you will learn in your technical courses. The Accreditation Board of Engineering and Technology, which accredits engineering and computer science programs, specifies six essential non-technical aspects of your education program that will make your career much more successful and rewarding. In fact, these non-technical skills or abilities are often much more important to career success than ability to solve engineering or computer science problems. These abilities or skills are:

- 1- **Function on multi-disciplinary teams**
- 2- **Understand professional, ethical responsibility**
- 3- **Communicate effectively**
- 4- **Broad education necessary to understand the impact of engineering solutions in a global and societal context**
- 5- **Recognition of the need for, and an ability to engage in life-long learning**
- 6- **Knowledge of contemporary issues**

In addition to these, we believe that when you become engineers or computer scientists, or if you chose another career field based on your engineering or CS experience, you will need to know the essentials of **business, management, law and entrepreneurship** because your work will involve aspects of all three fields.

There are many ways for you to acquire the skills and abilities described in the six categories above and the essentials of business, management, law and entrepreneurship at UMBC. We encourage you to take the courses that most suit your interest. Here are some suggestions:

1. **Function on multi-disciplinary teams:**

Most engineers and computer scientists will work on teams throughout their careers. Very few engineers or computer scientists will work alone in their companies of employment. Employers highly value ability to function on and lead multi-disciplinary teams in hiring and promoting.

In addition to ENES 101, Introduction to Engineering, which is required for Mechanical Engineering and Chemical and Biochemical Engineering students, several upper level design courses are structured to teach teamwork. These courses are opportunities to learn how to interact with fellow team members to divide responsibility and accomplish team goals. You should pay particular attention to the leadership role, because employers need engineers and computer scientists who are willing and able to assume responsibility for a team.

2. **Understand professional, ethical responsibility:**

We frequently hear from employers that it is not only important, but absolutely essential for their employees to be thoroughly grounded in professional and ethical behavior. In fact, unethical behavior of an employee can be very serious for a company and is cause for dismissal. In order to understand professional and ethical behavior, it is necessary to go beyond an understanding of personal morality. Engineers and computer scientists need to understand the kinds of situations that can and frequently do occur in the conduct of business that can have a serious negative impact on people if these situations are not handled correctly.

Several engineering and computer science faculty members include discussions and case studies of professionalism and ethics in courses where these issues fit with the course material. While these class discussions and case studies are essential, there is much more that you need to know about these issues.

A course in the Philosophy Department, **PHIL 251, entitled Ethical Issues in Science, Engineering and Information Technology**, is specifically designed to address the ethical and professional responsibilities you are likely to encounter in your career. This course is taught in the fall, spring, and summer to make sure you can fit it into your schedule. Other relevant courses include PHIL 150, Introduction to Ethics; PHIL 350, Ethical Theory; PHIL 358, Ethical Issues in Health; PHIL 454, Environmental Ethics and Policy; and PHIL 455, Applied Ethics.

3. **Communicate effectively:**

Your ability to communicate your ideas to others will determine whether you are successful in having your ideas understood and accepted. **This is probably the most important non-technical skill you will need.** UMBC's General Foundation Requirements include English 100, Composition, or its equivalent. In addition to this requirement you should consider: SPCH 100, Public Communication; ENGL 106, The Grammars of Speaking and Writing; ENGL 200, Language and Scientific Value, and any of the other courses in the English Department. In addition, a new First Year Seminar course, "Technological Disasters and Their Causes", will teach critical thinking and communication.

Many of the faculty members in the College of Engineering incorporate writing assignments designed to teach precise communication. Please take these assignments seriously and use the critique from the faculty to improve your communication ability.

4. Broad education necessary to understand the impact of engineering solutions in a global and societal context:

Throughout history, scientists and engineers have had a major impact on the world, generally very positive, but sometimes negative. The prospect of having a positive impact on society may have been one of the reasons you chose engineering or computer science as a profession. To help you understand the impact that your work might have, it is important to study the work and impact of other scientists and engineers.

UMBC has established a program of study in this field leading to an Undergraduate Certificate, entitled “**The Human Context of Science and Technology**”. The introductory course, **HCST 100**, explores interactions among the humanities, the sciences and technology and the effects of science and technology on art, philosophy, and society. For further information on this course and the certificate program, visit the HCST Web site at www.umbc.edu/hcst. In addition, there are several history courses that deal with the history of science and technology. There is a special section of HIST 102 of particular interest: **HIST 102, American History Since 1877, The Technological Century, Section 201 TR 1000-1115**, taught by Joseph N. Tatarewicz. In addition, there are many upper level history courses to consider later, such as HIST 445 and 446, History of Science Before and After 1700, and HIST 404, The History of Computers and Computing.

5. Recognition of the need for, and an ability to engage in life-long learning:

Throughout your career the body of knowledge that you will need to understand will continue to expand, just as it has in the past. Professionals find that they must keep up, not only in their own field, but in related fields. In fact, the breadth of your education will continue to expand with life experiences and specific courses in your field. Many of your courses will require that you learn beyond the textbook and learn to think critically.

UMBC does not specifically teach a course in life-long learning, but we encourage you to take advantage of the breadth of courses available to expand your horizons beyond your chosen field. A broad liberal arts education is an excellent complement to your technical education.

6. Knowledge of contemporary issues:

It is essential to keep abreast of what is happening in the world as you go through life. Many of your technical courses will introduce contemporary issues as part of the classroom discussion. In addition, there are various courses that deal with current issues, such as those in the American Studies Department and the Political Science Department. For instance, AMST 310, Gender and Inequality in America, and POLI 319, Selected Topics in Political Philosophy, deal with gender and race issues that affect us all. You should explore opportunities to deal with current issues in some depth so that you will learn how to think critically.

7. Essentials of business, management, law, and entrepreneurship:

Throughout your career, many of your actions will involve decisions that you or your management must make. Often, these decisions will involve the use of limited resources that should be invested wisely. Decision or engineering economics is the application of economic criteria to help select the best of a group of technically feasible alternatives, by bringing costs and benefits (which often occur at different times) to a common basis for comparison.

UMBC offers several courses in the Economics Department that are applicable, such as ECON 101, Principles of Microeconomics; ECON 309, Economics and Finance for Scientists and Engineers; ECON 121, Principles of Accounting, and ECON 405, Benefit-Cost Evaluation, and ECON 408, Managerial Economics.

Throughout your career you will probably be involved in management and legal issues that you will need to understand. There are several courses in management and law that you should consider: ECAD 210, The Practice of Management; ECAD 361, Business Law I; ECAD 362, Business Law II; ECAD 385, Law, Business Ethics, and Society; ECAD 410, Production Management; POLI 233, Law and the Legal System.

Entrepreneurship is a skill that you will likely need also, for various reasons: You may be part of a new venture within the company where you are employed; you may be involved in starting a new company; you will probably need to market yourself to others for promotion or a new position. UMBC offers a course in entrepreneurship ENES 200, entitled “Introduction to Science and Technology Entrepreneurship.” The course provides an overview of the basic concepts and focus on the nature, environment, and risks of new venture formation and technology commercialization. You can learn more about this new course at the Web site: www.continuinged.umbc.edu/entrepreneurship